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Non-linear relationship between maternal work hours and child body weight: Evidence from the Western Australian Pregnancy Cohort (Raine) Study

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Supplementary notes*

*Article: Jianghong Li, Plamen Akaliyski, Jakob Schäfer, Garth Kendall, Wendy H.Oddy, Fiona Stanley, Lyndall Strazdins. Non-linear relationship between maternal work hours and child body weight: Evidence from the Western Australian Pregnancy Cohort (Raine) Study. *Social Science & Medicine* 2017, 186:52-60.

Note 1. Straker and co-authors (2017) have compared the health, demographic, and socioeconomic characteristics of the Raine Cohort with those of the WA population at birth, in middle childhood (age 8), adolescence (age 14 and age 17), and in young adulthood (ages 20-22). The authors concluded that the Raine Cohort does not differ from the general population of children and adolescents in Western Australia on these characteristics, other than a higher proportion of the Raine cohort's parents have post-secondary or tertiary education, have medium level income, live in urban than rural areas, and are in clerical/retail or professional/managerial occupations. Straker et al (2017) also assessed possible attrition bias of the Raine Cohort by comparing the birth characteristics of the participants at each follow up (ages 2, 3, 5, 8, 10, 14, 17, 20, 22) to the characteristics of those who dropped out of the cohort at various time points. These characteristics included premature birth or full term birth, birth weight, birth weight in relation to gestational age, birth complications, and ethnicity. The participants and drop-outs are remarkably similar across all follow ups, except a higher proportion of Aboriginal children dropped out of the study. But this group made up less than 3% of the original cohort. Imputing variables in missing waves is highly complex and it only produces very small improvement in estimates in fixed effects models (Young & Johnson 2015). In light of these factors, excellent average response rates for the ages analyzed in this paper (> 80%), and the fact that there are no benchmark weights developed for the Raine Study, we could not weight our analyses.

More information about the Raine Cohort recruitment and method has been documented elsewhere (Newnham et al. 1993).

Johnson, David R., Young, Rebekah. "Handling Missing Values in Longitudinal Panel Data With Multiple Imputation". *Journal of Marriage and Family*. 2015;77;1:277-294.

Newnham, J.P., Evans, S.F., Michael, C.A., Stanley, F.J., Landau, L.I. 1993. Effects of frequent ultrasound during pregnancy: A randomised controlled trial. *Lancet*. 342, 87-891. doi:10.1016/0140-6736(93)91944-H

Straker, L., et al. "Cohort Profile: The Western Australian Pregnancy Cohort (Raine) Study-Generation 2". *International Journal of Epidemiology*. 2017;1-12.

Note 2. We used the MI command in STATA 14 to impute the missing cases. The procedure generated 25 imputed datasets based on all variables analyzed in our study. The random- and fixed-effects models were then estimated based on these imputed datasets. The marginal effects reported were based on the RE and FE models using the non-imputed data, however. This was due to the fact that the procedure for calculating marginal effects based on the final multiply imputed estimates from RE and FE models is not (yet) implemented in STATA. Since the RE and FE coefficients are very similar in terms of magnitude between the non-imputed data and the imputed data and only differ mainly in p-values (higher in the non-imputed samples than in imputed data, especially true for young age), we can assume that marginal effects in the non-imputed data, if different at all, would be somewhat underestimated, rather than overestimated.

Note 3. The categories of work hours for both mothers and fathers were defined based on a combination of the theories, empirical explorations and national work patterns for women and men in Australia. The theories discussed in the paper suggest three broad categories: no employment, part-time employment, and full time employment. We plotted mother's weekly work hours against the probability of being overweight or obese using different increments: 1 hour, 5 hours, and 10 hours.

This preliminary analysis showed that 35-40 was the point where the probability of being overweight or obese was the lowest for the age group of ages 8 to 14. Consistently, the national average weekly work hours for women working full time during the period of 1998 to 2002 when the cohort were aged 8, 10, and 14 years fell within the same range of 35 to 40 hours based on Australian Bureau of Statistics (2010). We also tested alternative categories of maternal work hours in RE and FE models, including 11 categories for ages 8-14. These categories included: 0, 1-9, 10, 11-19, 20, 21-19, 30, 31-39, 40 (reference), 41-49, and 50 or more. We found a similar curvilinear relationship: all categories below 40 were positively associated with the likelihood of overweight and obese, and hours above 40 were also positively and even more strongly associated with the outcome variable. To make the models more efficient to estimate and the work hour categories practically meaningful, we eventually collapsed 11 categories into five as used in all multivariate models. Importantly, based on the data plot with 5 hour increments and the national average work hours for women working full time in Australia in the relevant time period, we modified the reference category: from 40 hours per week to 35-40 hours per week. Similar approaches were used to determine the maternal work hour categories for the younger age group (2-5). Based on the preliminary analysis, the theories and the national averages of work hours for women, Table 1 was produced to illustrate two different work hour categories for mothers with different plausible thresholds for the two age groups.

Australian Bureau of Statistics (ABS). 2010. Australian Labour Market Statistics 6105.0, Oct 2010.

Note 4. We tested quadratic terms for maternal hours as a continuous variable, separately by age group (ages 2-5, ages 8-14). There was a weak significant quadratic relationship (at $p < 0.10$ level) between mother's work hours as a continuous variable and the likelihood of becoming overweight or obese. When non-working mothers were excluded from the analysis, the quadratic relationship was significant ($p < 0.05$). We believe this justifies our approach and work hour categories. We have also analyzed the BMI Z-- scores and cubic and quadrupled terms for maternal work hour and found a weak effect with the 10% significance level ($p = 0.10$).

Note 5. Maternal education was measured at two time points: in pregnancy and when the child was aged 8, with different categories. Maternal education in pregnancy was analyzed for preschool-aged children (ages 2-5) and maternal education at age 8 was analysed for school-aged children (ages 8 to 14).

Note 6. The age differences in the results are unlikely to be due to the different ways in which some control variables were collected, such as income ranks, maternal education and father's employment for the two age groups (ages 2-5 versus ages 8-14). Nor do we consider that the age patterns can be attributed to the fact that not the same number of control variables was included in the analysis separate by age group: e.g., child care was not included in the analysis for ages 8-14 because this variable is irrelevant and was not collected; maternal mental health was not collected for ages 2 to 5 and hence could not be controlled for. We have re-run the models presented in Tables 2, 3, 4 and 5 using only control variables that were collected for both age groups and that were measured in the same way. The results remained unchanged (results are available upon request as we already have a large amount of supplementary material).